Please delete the paragraph at page 1, line 20, to page 2, line 5, including the section heading, and replace it with the following replacement paragraph:

BACKGROUND OF THE INVENTION ~~BRIEF SUMMARY OF THE INVENTION~~

Analog flow rate measuring and controlling units are known with which differential pressure measurement is effected by way of an orifice or other restriction in a flow channel to determine the rate of flow. Following that, the value obtained by this measurement is compared with a desired value in a calculating unit. If the actual value differs from the desired value specified the calculating unit emits a correcting signal for application to a proportional valve unit which then initiates a correcting process to cause the measured value of the flow rate to coincide with the desired value.

Please delete the paragraph at page 5, line 21 to page 6, line 12, and replace it with the following replacement paragraph:

The flow block 6 guides the fluid from the inlet tube 16, through a right angle turn, expanding to a rectangular cross sectional area that is smaller than the circular cross sectional area of the inlet tube 16. In a preferred embodiment, the inlet tube has about a 0.25 inch ID, and the outlet tube, when used in conjunction with honeycomb 20, is about 0.5 inch narrowing to about 0.25 inch. In the preferred embodiment, as used on a soda dispensing system, the rectangular cross section has a width that ranges from about 0.25 inch to about 1 inch with about 0.5 inch being most preferable; a height that ranges from about 0.02 inch to about 0.065 inch with 0.025 inch being preferable; and a length that ranges from about 2.2 inches to about 1.4 ~~inched~~ inches. In an alternative embodiment, height of recess 22 is stepped. In this embodiment, the height decreases from about from about 0.04 inch to about 0.03 inch across the length of said recess 22. The fluid velocity increases at this area of recess 22. A pressure sensor port 24 is located

at the beginning and at the end of this transition detecting any change in pressure caused by increased velocity and by turbulence.

Please delete the paragraph at page 6, line 13 to page 7, line 3, and replace it with the following replacement paragraph:

A temperature sensor 26 is also located on the fluid surface of the Flow Block 6 in this area. It projects slightly, but does not significantly interfere with the flow. The fluid then continues across several recessed grooves 28, which cause increased turbulence in the fluid. The turbulence causes pressure of the fluid to drop. Another pressure port is located after the grooves 28. The fluid then meets a pitot-tube type port 30. Traveling around this port it then exits through the honeycomb flow conditioner 20 and outlet hole 18. In an alternative embodiment, the pitot tube can be replaced by a step that reduces the cross-sectional area of the flow path. In one example of this alternative embodiment, said step is a reduction in height of recess 22 across its length. For example, said height can decrease from about 0.04 inch near the inlet hole to about 0.03 inch at the outlet hole. This alternative feature is not as restrictive as the [[pilot]] <u>pitot</u> tube and is less prone to clog from debris. Like the [[pilot]] <u>pitot</u> tube it has an element of density dependence because the fluid velocity must increase.

Please delete the paragraph at page 8, line 18 to page 9, line 10, and replace it with the following replacement paragraph:

It has been determined that the largest pressure drop with soda water is at the 90 degree bend. Increasing the height or width of the flow path will decrease the total pressure drop of the soda water because it opens the flow path, and decreases the fluid velocity change. The largest pressure drop using syrup is over the rectangular cross-section because of its higher viscosity. Increasing the height or width of the flow path will also decrease the total pressure drop of the syrup. However, the relationship between the height of the flow path and the [[fluid]] <u>pressure drop</u> is much stronger with syrupy

fluids than with watery fluids. Small changes in the height will affect the pressure drop with syrup much more than with water. This difference allows the pressure limits to be matched to their required values (e.g., soda water to 40 psi and syrup to 20 psi). The height is the most critical factor in the matching. The length of this restriction can also be adjusted to increase or decrease the pressure drops. Thus the current invention, therefore, creates a single path that produces optimal pressure drops for a variety of fluids (e.g.., 40 PSI pressure drop with soda water at 4 oz/s, and a pressure drop of 20 PSI using cold sugar syrup at 1 oz/s).

Please delete the paragraph at page 9, line 17, to page 10, line 11, and replace it with the following replacement paragraph:

A highly density dependent pressure drop occurs at the transition between the first two sensors at the 90 degree bend, and a highly viscosity dependent pressure drop occurs across the flat cross-section area. Having one signal that is highly density dependent and one that is highly viscosity dependent is a key element of the flow meter design, discussed below. Thus, the flow meter of the current invention is at least three meters in one, wherein every detected pressure drop is an indicator. The use of the pressure drop across the 90 degree transition, for example, could be used on [[it's]] its own to determine the flow rate; however, such single metered measurements are often inaccurate. By placing another one right in line (pressure drop across the thin area), the second meter can be used to both check other conditions or fluid properties and correct the data collected by the first meter. Under some circumstances, those two might show a flow rate, but they may also be inaccurate, so the third indicator (another pressure sensor or temperature sensor) can be used to check them and correct them. Thus the flow meter of the current invention has at least three sensors for measuring three independent variables: flow, viscosity, and density, (temperature is a function of viscosity and density for sugar syrups, so it is not independent), as well as to correct data collected in the first meter.

Please delete the paragraph at page 11, lines 1-6, and replace it with the following replacement paragraph:

A sensor housing 12 [[was]] <u>is</u> placed around the pressure sensor 8 assemblies. The geometry of this sensor housing 12 closely duplicates the original MEMS pressure sensor housing. The sensor housing 12 holds the pressure sensor 8 assemblies in the right location over the ports 24. The conductive pressure sensor gaskets are left exposed to contact the contact board 14. The gaskets on the opposite side seal against the flow block 6.

Please delete the paragraph at page 11, lines 7-10, and replace it with the following replacement paragraph:

A thermistor 10 is mounted in the flow block 6 so that it is in contact with fluid in the inlet area. Small conductive contact pins are soldered to the thermistor leads. These contact pins ~~protruded~~ <u>protrude</u> through the sensor housing 12 and are positioned to make electrical contact with the contact board 14.

Please delete the paragraph at page 12, line 22, to page 13, line 7, and replace it with the following replacement paragraph:

Data acquisition and process control software and hardware is installed and programmed on a PC. This equipment is used to drive the piston pump, tare and read the scale, read the voltage values from the analog test board and provide time stamps for each sample of the data. Before each run, the scale is ~~tarred~~ <u>tared</u>. Next, the piston pump is activated. Voltage samples are then taken across all channels of the analog test board every 10 ms through the duration of the run. After the run, the scale is read, and a text file is generated and saved. The file contains a log of the programmed settings, voltage readings with corresponding time stamps, and the final scale reading.

Please delete the paragraph at page 13, line 8, to page 14, line 2, and replace it with the following replacement paragraph:

The system is calibrated to generate a flow rate value based directly on the readings from the pressure sensors 8 and the thermistor 10. This is unlike the flow meters of the prior art wherein the data acquired from pressure sensors is combined with a variety of other data, such as inlet duct size diameter, ~~renolds~~ Reynolds equations and the like, for making calculations of flow rate. For the current invention, a matrix is developed allowing the flow rate of a test sample to be calculated directly from the pressure voltage. A given fluid is pumped through the flow body 2 at a constant flow rate using the piston pump. Pressure readings are sampled along with temperature. The flow rate is then changed and the corresponding pressures and temperature are again sampled. Changes in temperature of the fluid creates pressure changes at a given flow rate, so several temperatures are sampled at several flow rates for each fluid. The process is repeated with different fluids, thereby generating a matrix containing flow rate, pressure and temperature data for the fluids. The pressures that are used in the matrix are the differential pressures (differences between separate pressure ports 24 generated on the analog test board). Two or more of these different values are used to generate the flow rate algorithm.

Please delete the paragraph at page 16, lines 1-4, and replace it with the following replacement paragraph:

The shape of the pressure to flow rate relationship has much to do with the ~~Renolds~~ Reynolds number and with whether the flow is laminar or turbulent or is going through transition. It is preferred that the flow is either in a laminar state or a turbulent state because of inconsistencies in the transitional areas.

Please delete the paragraph at page 16, lines 5-17, and replace it with the following replacement paragraph:

If a mathematical formula is used, it is unlikely that the data from [[of]] soda water, diet syrup and sugar syrups under all temperatures and flow rates will fit well using a single formula. Basic information from the indicators can be used to classify the fluid. Separate formulas can be generated during the calibration process, and selected based on the fluid class. For example, when sugar syrups are in the system, the ratio between the Port A-Port B pressure drop and the Port B-Port C pressure drop is very different than when soda water or diet syrups are flowing. (Port A, B, C and D refer to sensor ports 24, and are generally aligned according to Figure 3. The ports are aligned by way of example only, and an alternative aligning of the ports does not depart from the spirit of the current invention.) To tell the difference between soda water and diet syrup, magnitude of the Port A-Port B pressure drop can be used. It will be higher with soda water because of the higher flow rate.

Please delete the paragraph at page 17, line 14, to page 18, line 6, and replace it with the following replacement paragraph:

In an alternative embodiment of Applicant's flow meter system, the pressure sensors 8 are differential pressure sensors. Differential pressure sensors, where fluid is applied to both sides of a strain gage-type membrane, are much more resistant to damage by a pressure spike because the force of the pressure is applied on both sides of the meter. By using differential pressure sensors 8, the reading between two ports that generate a pressure drop of 15 PSI, for example, can be measured using a 15 PSI pressure sensor. If using gage pressure sensors, all of the sensors should have a significantly higher rating in order to withstand pressure spikes in the line. Pressure spikes can be as much as several hundred PSI, which will damage most gage sensors. Large pressure spikes can be further reduced with the [[uses]] <u>use</u> of a plenum. A plenum is a small ~~camber~~ <u>chamber</u> filled with air or other compressible material that is in contact with the inlet fluid. As pressure spikes or vibrations travel toward the meter, they are damped by

the plenum. The plenum can absorb and release the fluid's kinetic energy, thereby smoothing the fluid flow and preventing damaging pressure spikes.

Please delete the paragraph at lines 17-22 of page 19 and replace it with the following replacement paragraph:

A preferred method is to use properly temperature compensated pressure sensors and remove the sensors from the flow path to further reduce the possibility of errors due to rapid fluid temperature changes. If the algorithm resets the pressure value to zero before each run, the temperature effects will have a minimal impact on accuracy so long as the pressure sensors are buffered from dramatic ~~changed~~ changes in temperature during the run.

Please delete the paragraph at page 20, lines 6-16, and replace it with the following replacement paragraph:

There are at least three ways to reduce errors caused by bubbles in the routing. A first method is to locate the ports below the flow path. A second method is to make the port routing relatively large after the initial port hole. This way if a bubble does get into the routing, its effects will be minimized. Third, a membrane can be located between the flow path and the ports. It must be flexible in order to effectively transmit the pressure. Those of ordinary skill in the art will readily exercise a variety of methods for eliminating or minimizing the errors caused by bubbles in the routing line. Alternatively, elongating the pressure ports across the flow path can reduce errors caused by localized swirling of the fluid. This also allows fluid to travel in and out of the port more freely, reducing errors [[cause]] caused by bubbles.

Please replace the paragraph at page 21, line 21, to page 22, line 12, with the following replacement paragraph:

During calibration, ideally a fluid is pumped through the meter at a programmed, known rate. If the actual flow rate deviates from the programmed flow rate (due to vibration, tube compliance[[.]], pump ramping[[.]], plenum dampening, etc.) error will be introduced to the system. This error can be greatly reduced by ensuring steady state conditions or by generating a temporary flow rate estimate. A temporary flow rate estimate can be generated by observing a single pressure drop signal through the run and making a simple calibration for that run [[base]] based on it. Since the conditions (temperature and fluid) are relatively stable for a single run, a simple estimate of the flow rate can be generated based on a single pressure sensor reading. This temporary flow rate estimate accurately tracks small unintentional changes in flow rate. These estimated changes are then [[be]] associated with the small variations of the readings at any point in time in the run. The data set that is gathered will have more accurate flow rate information, thus improving the accuracy of the final calibration, when all of the data is used to [[crate]] create a general formula or is used in an interpolation data set.